

# Solar Occultation Measurements of ozone in the Lower Stratosphere and Upper Troposphere

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H. J. (Ray) Wang, Derek M. Cunnold  
Eun-Su Yang

School of Earth and Atmospheric Sciences  
Georgia Tech., Atlanta, GA

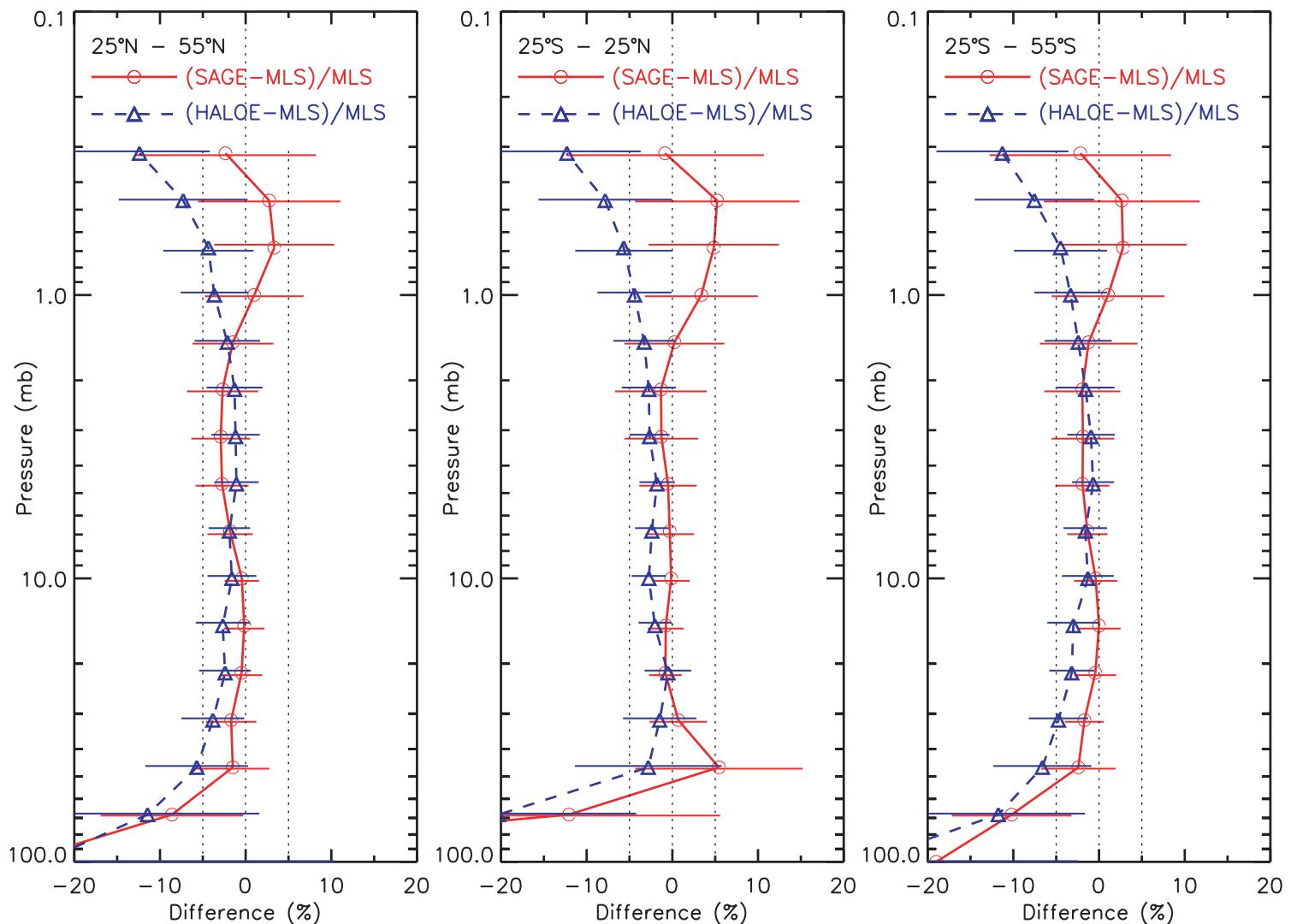
SOSST Meeting, Williamsburg, VA, May 6-7, 2003

# Why LS/UT regions

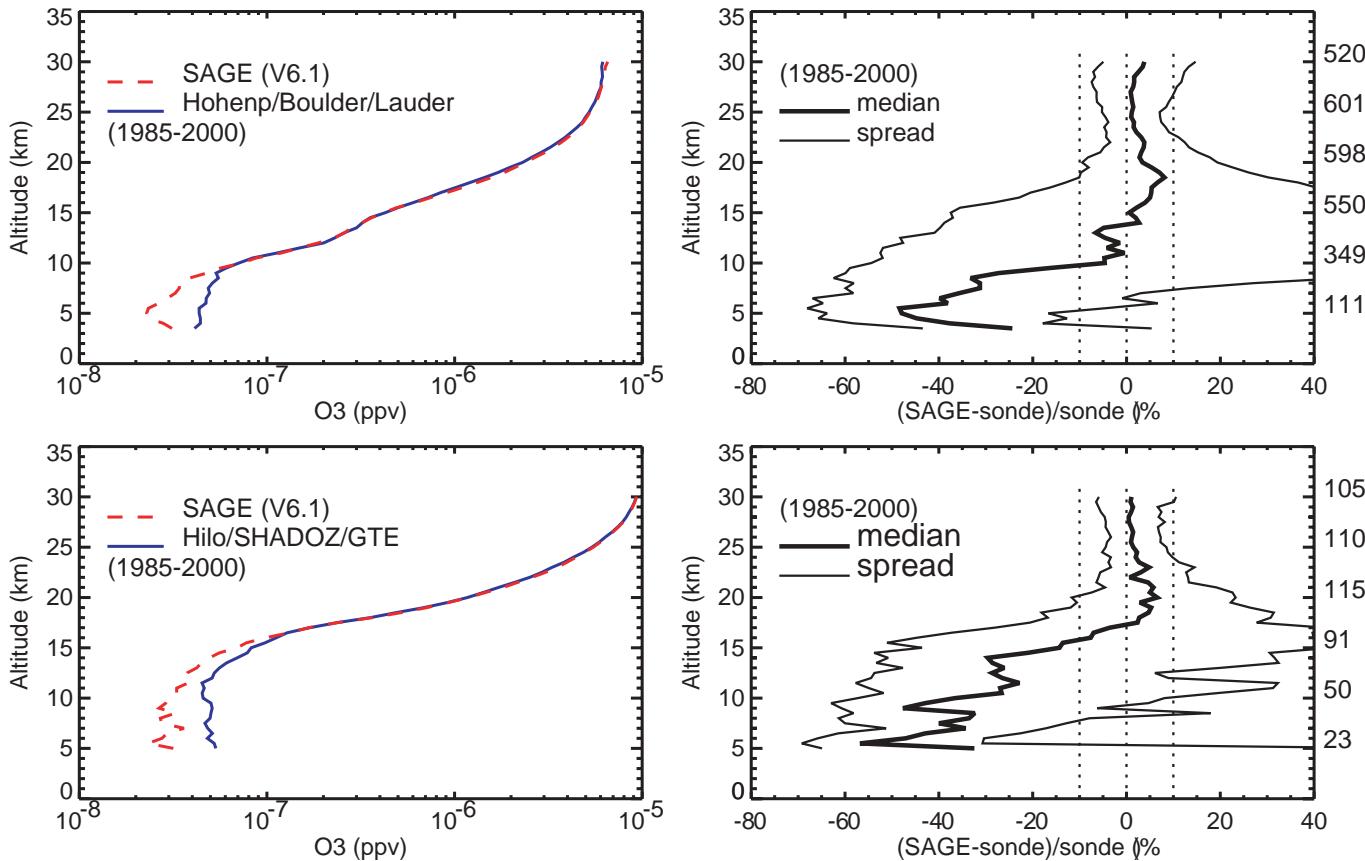
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- ◆ Scientifically interesting area, for example
  - Stratosphere/Troposphere Exchange
  - How water vapor enters stratosphere and got dehydrated
  - Ozone losses (trends)
  
- ◆ Challenging for solar occultation measurements
  - Ozone signal is smaller
  - Interference from other species is larger
  - Dynamic variability is larger

zonal mean ozone difference and standard dev. (10/91–12/99)  
 SAGE(V6.1), HALOE(V19), MLS(V5)

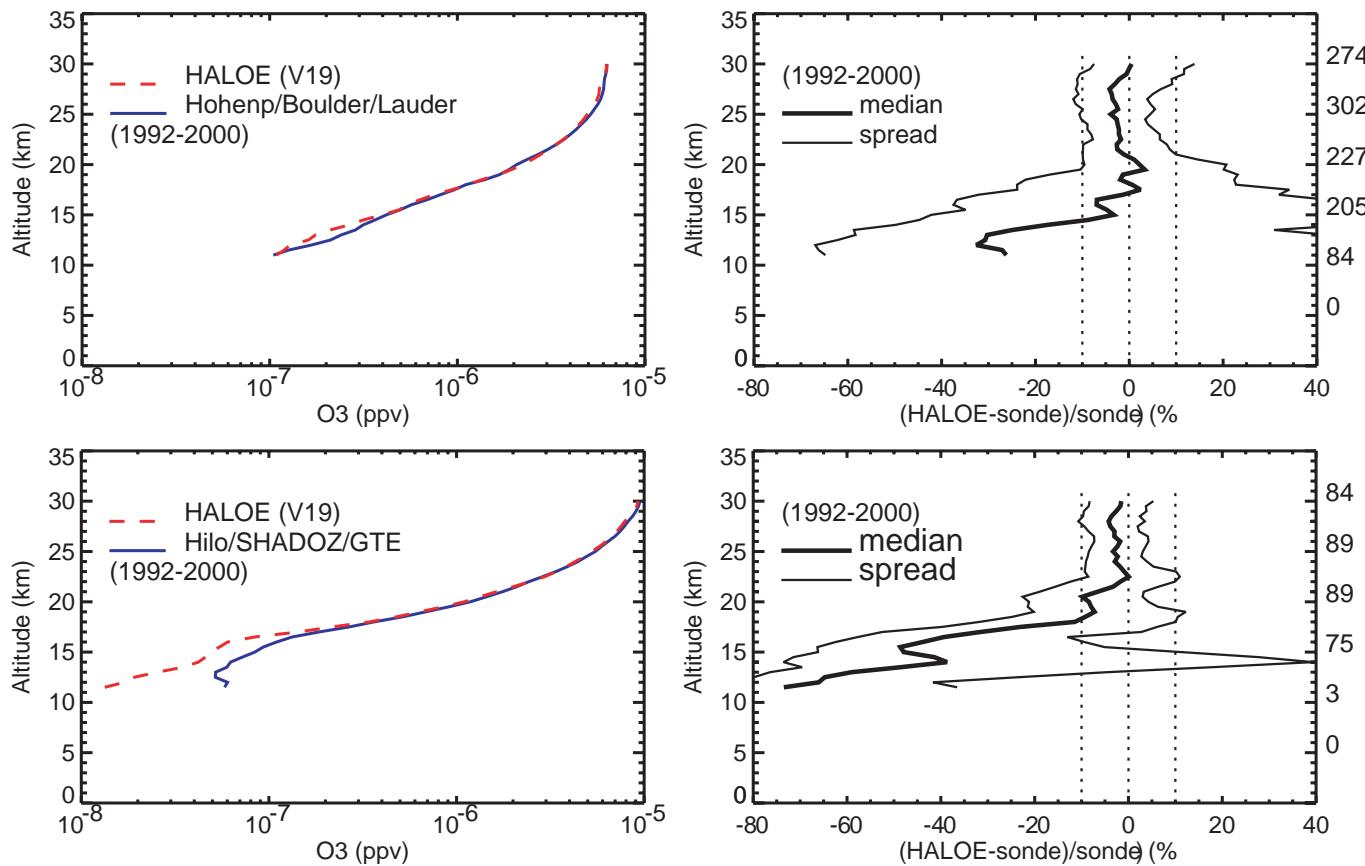


## Comparisons between SAGE (V6.1) O<sub>3</sub> and ozonesondes



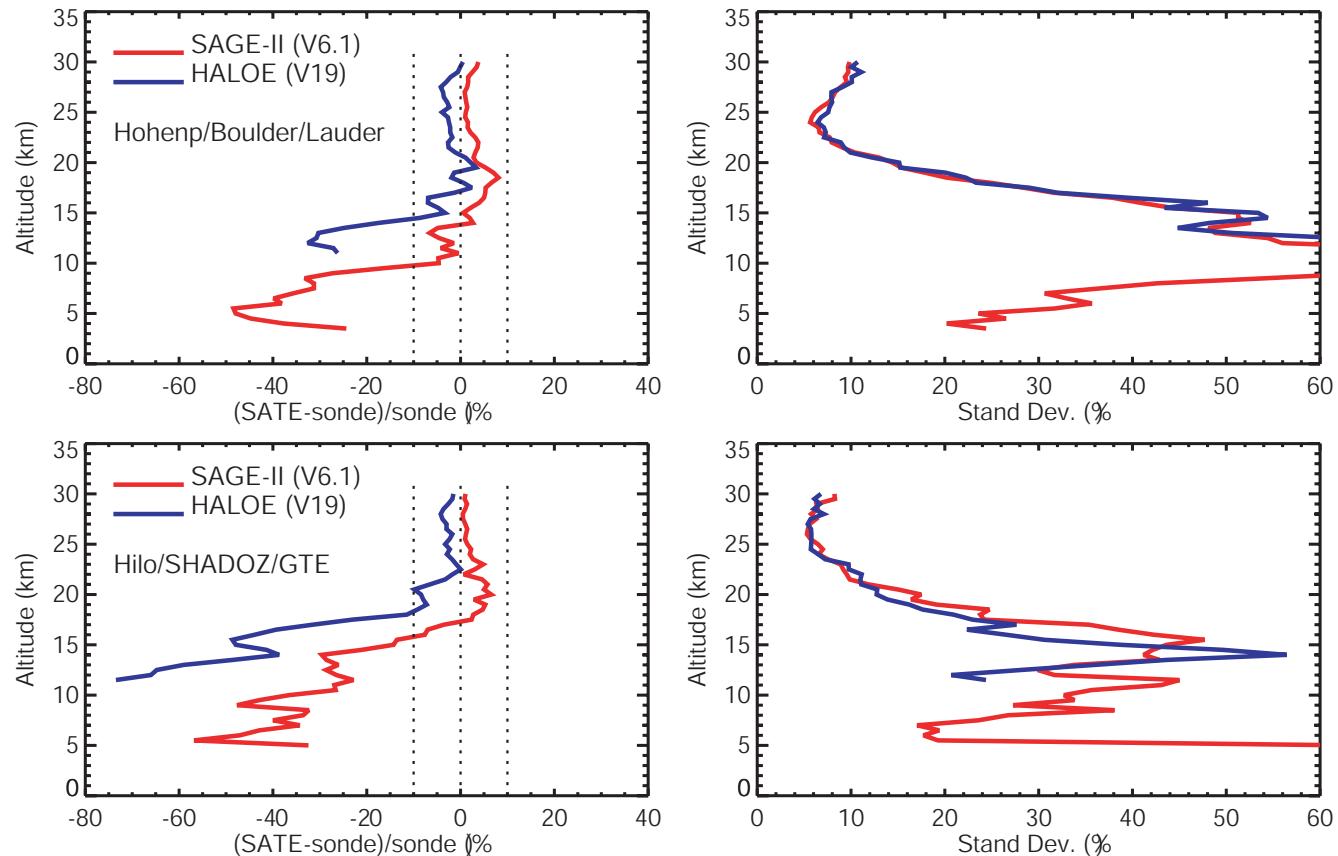
The spreads indicate the 16<sup>th</sup> (e.g. mean- $\sigma$ ) and 84<sup>th</sup> (e.g. mean+ $\sigma$ ) percentile values in the distribution of the differences (Wang et al., 2002)

## Comparisons between HALOE (V19) O<sub>3</sub> and ozonesondes

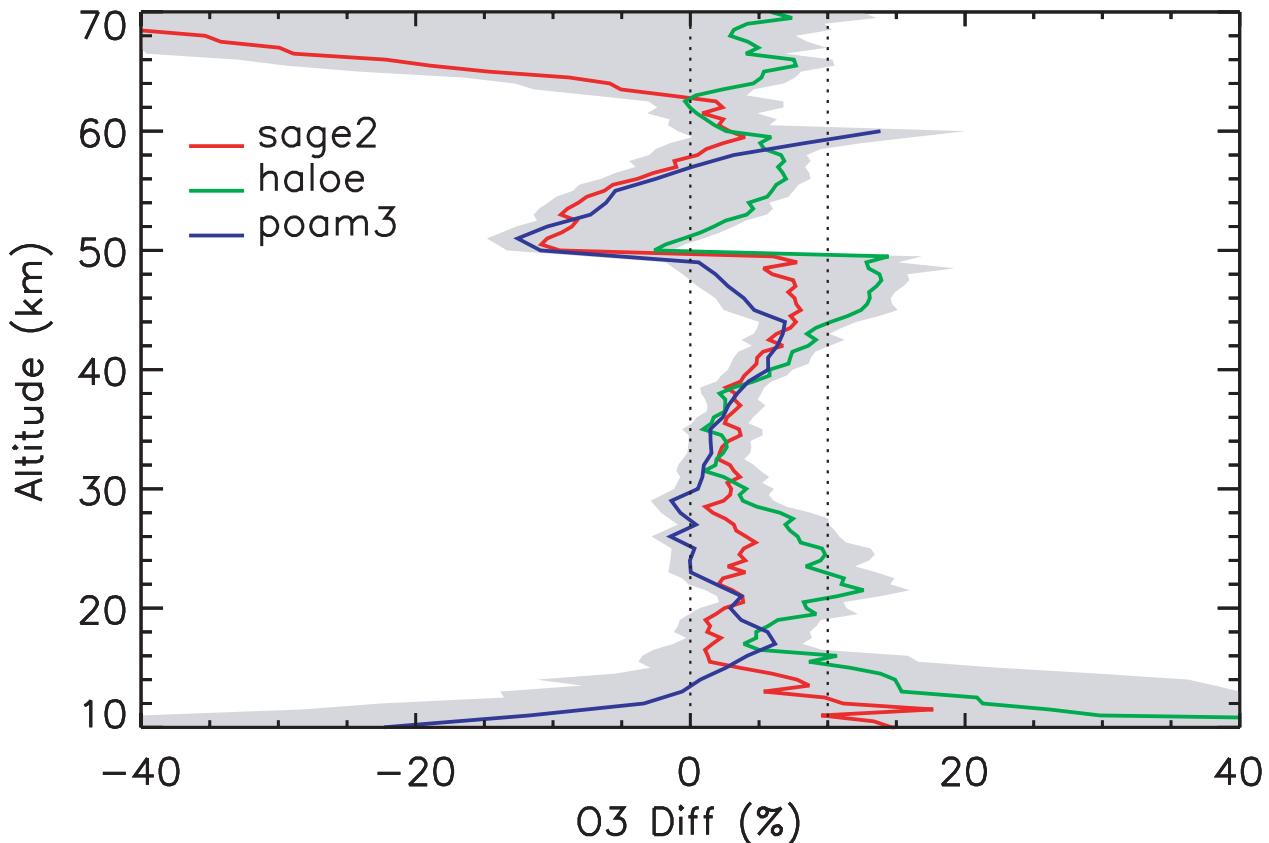


The spreads indicate the 16th (e.g. mean- $\sigma$ ) and 84th (e.g. mean+ $\sigma$ ) percentile values in the distribution of the differences

## Comparisons between SAGE/HALOE O3 and ozonesondes



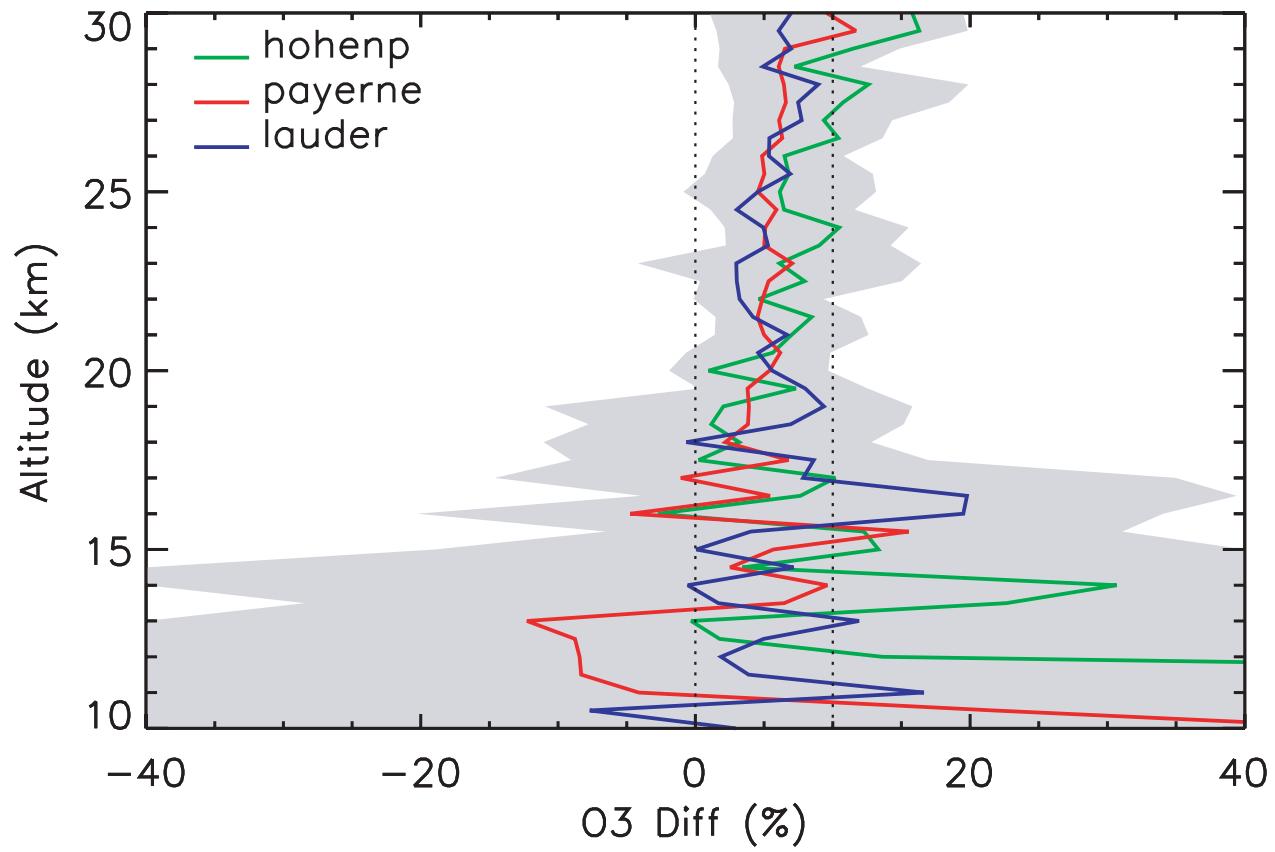
Mean O<sub>3</sub> diff. and errors (2-sigma) between  
SAGE-3 and correlative measurements



- May to Dec. 2002
- Collocated criteria
  - 2° in latitude
  - 12° in longitude
  - 24 hr in time
- Collocated profiles
  - SAGE-II (127)
  - HALOE (118)
  - POAM-III (198)

$$(\text{SAGE3} - \text{corr})/\text{corr} * 100\%$$

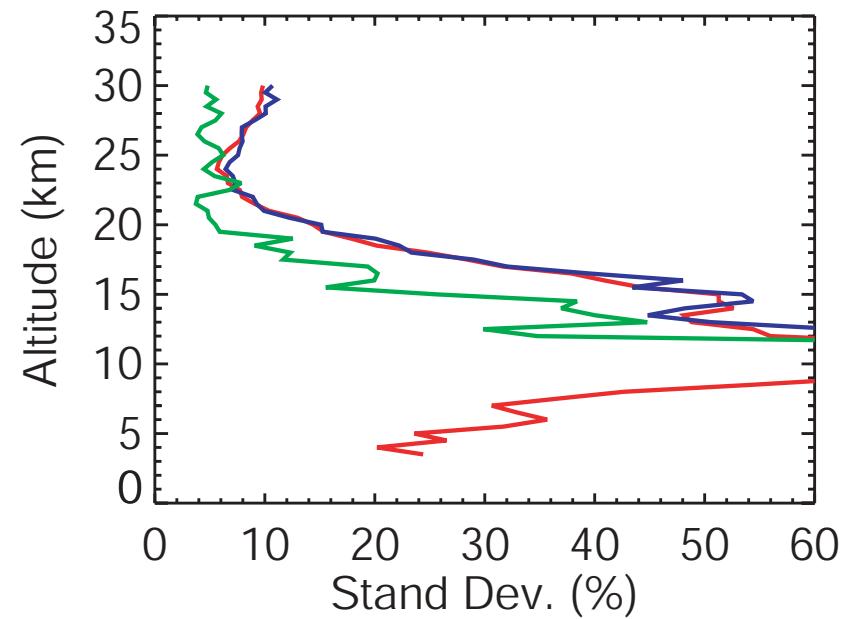
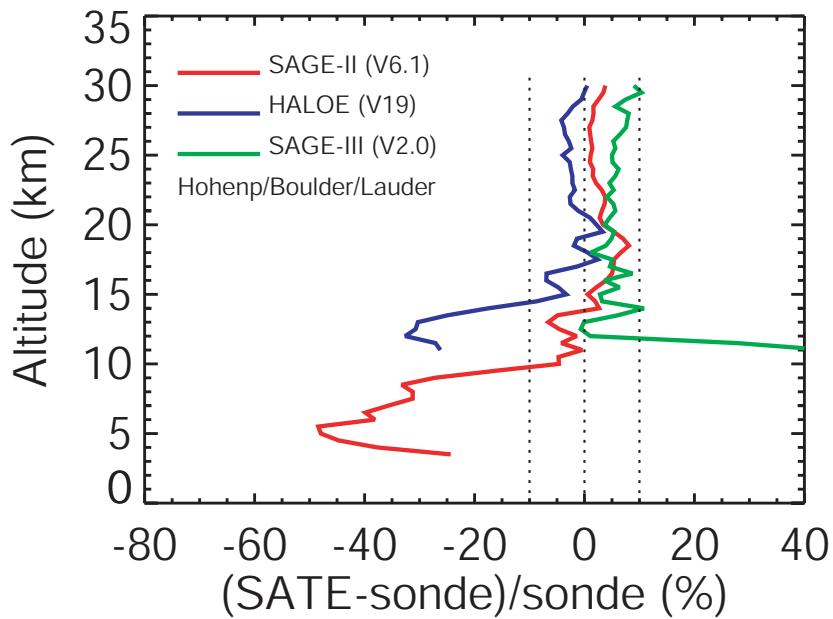
## SAGE-3/sondes mean diff. and errors (2-sigma)



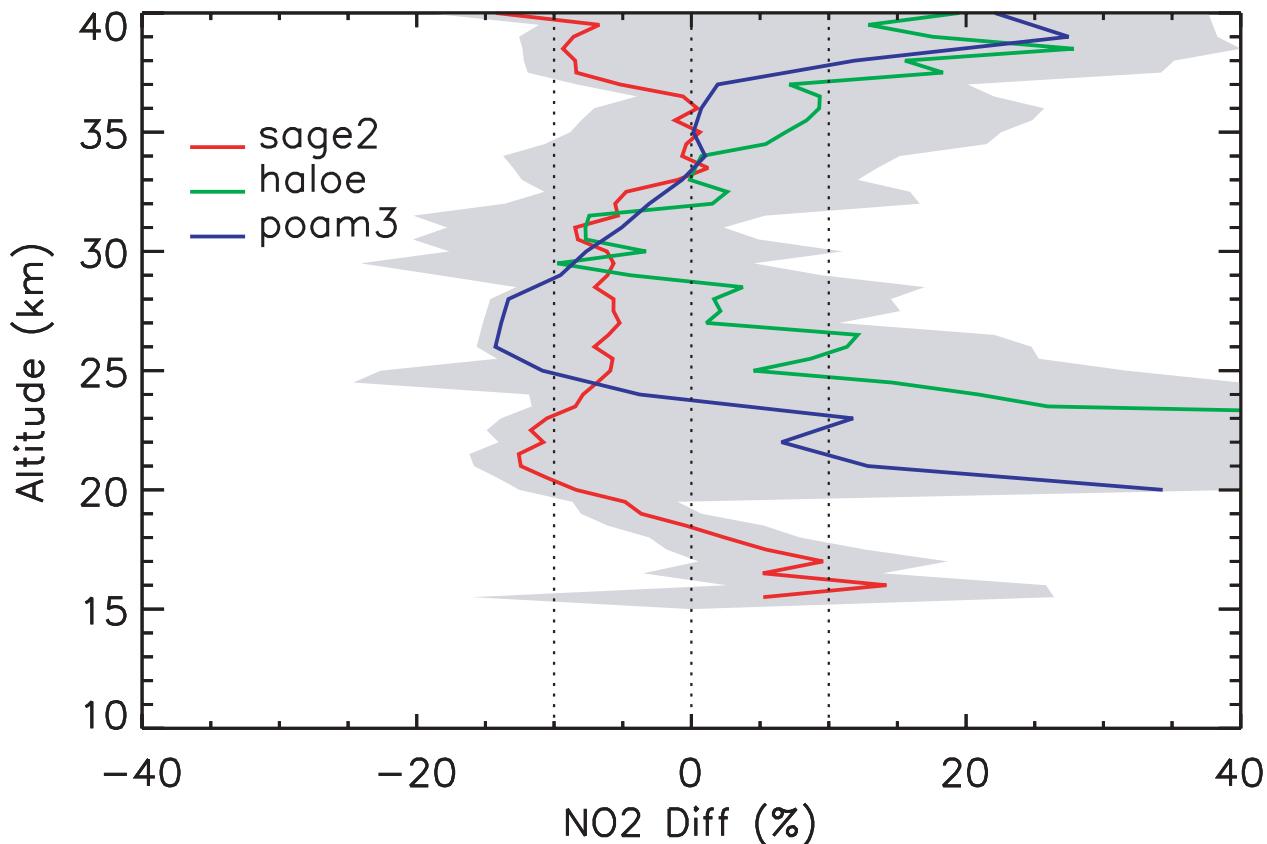
- May to Dec. 2002
- Collocated criteria
  - $2^{\circ}$  in latitude
  - $12^{\circ}$  in longitude
  - 24 hr in time
- Collocated profiles
  - Hohenp. ( 8)
  - Payerne (16)
  - Lauder (13)

$$(\text{SAGE3} - \text{sonde})/\text{sonde} * 100\%$$

## Comparisons between SAGE/HALOE and ozonesondes



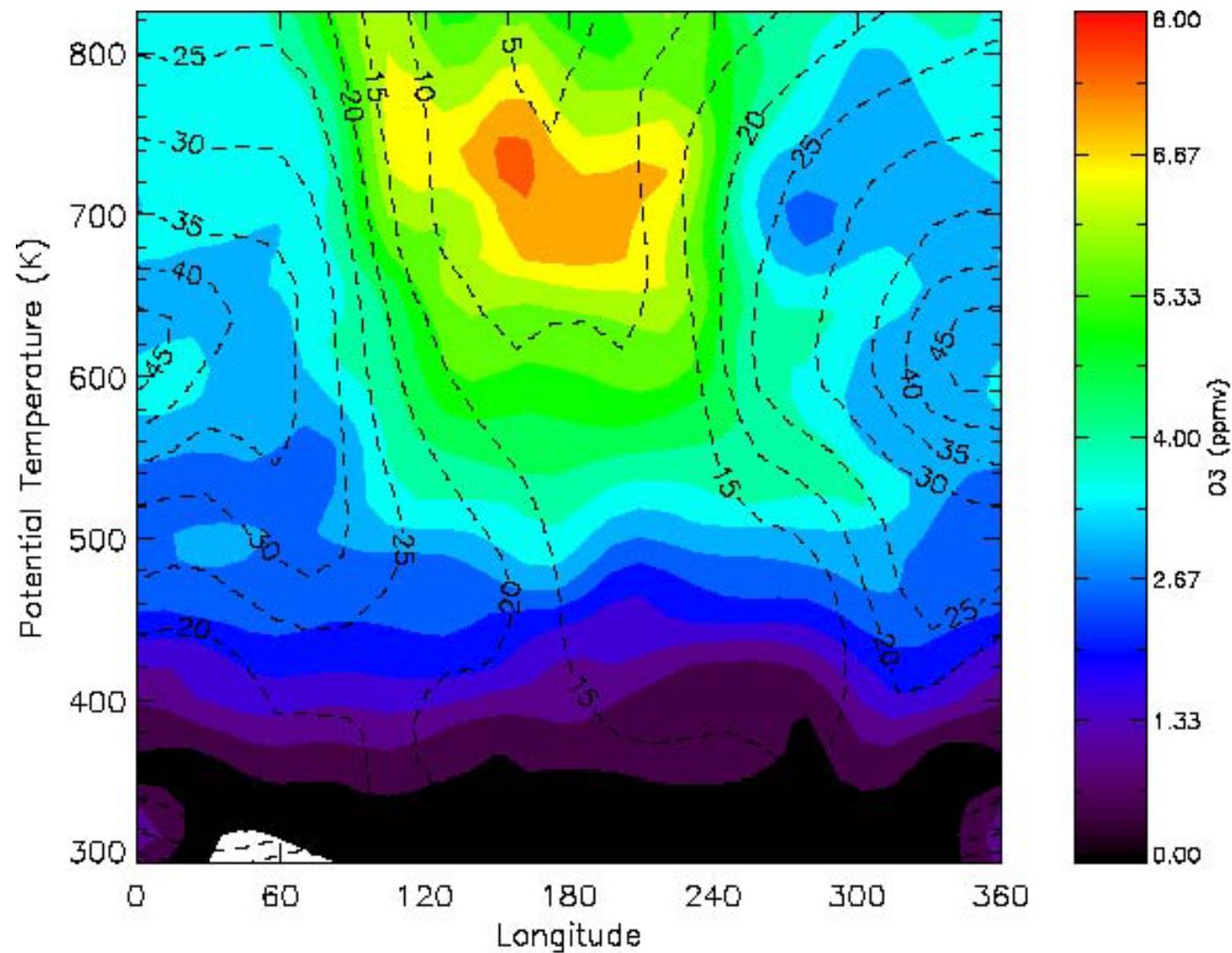
Mean NO<sub>2</sub> diff. and errors (2-sigma) between  
SAGE-3 and correlative measurements



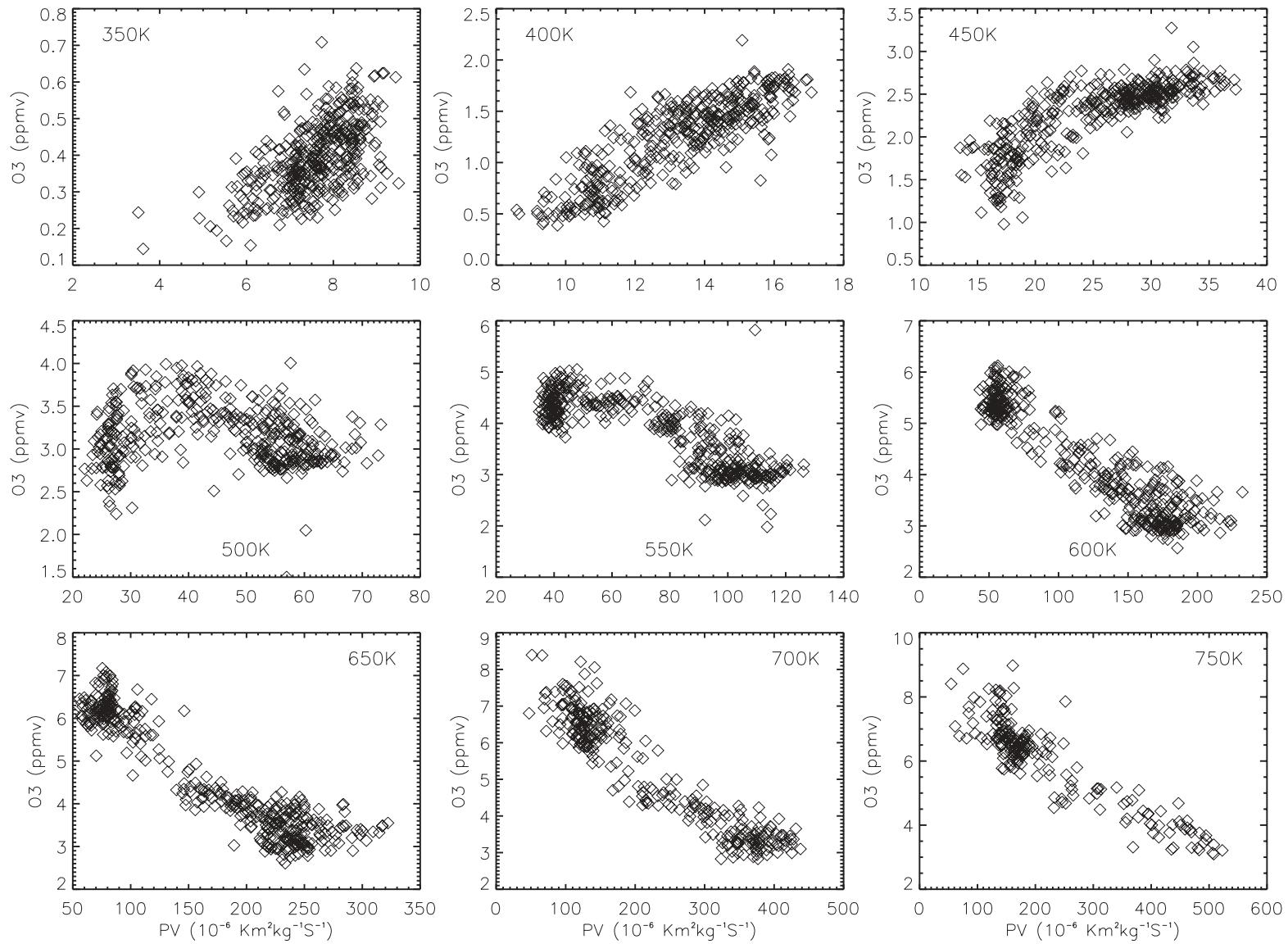
- May to Dec. 2002
- Collocated criteria
  - 2° in latitude
  - 12° in longitude
  - 24 hr in time
- Collocated profiles
  - SAGE-II (110)
  - HALOE (118)
  - POAM-III (198)

$$(\text{SAGE3} - \text{corr})/\text{corr} * 100\%$$

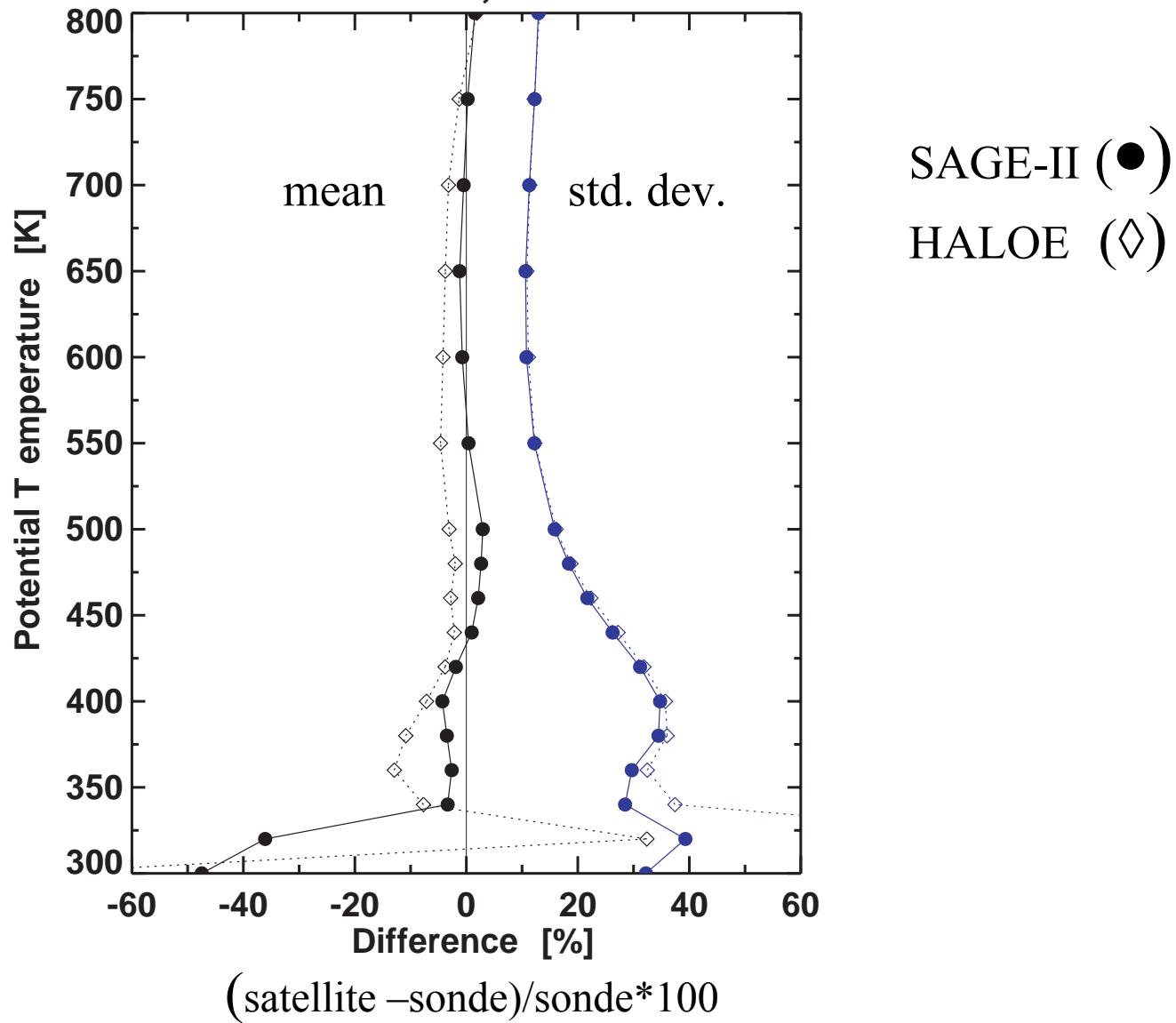
SAGE-3 (V2.0) Sunset O<sub>3</sub> data on Dec. 27, 2002 (65.5° N)



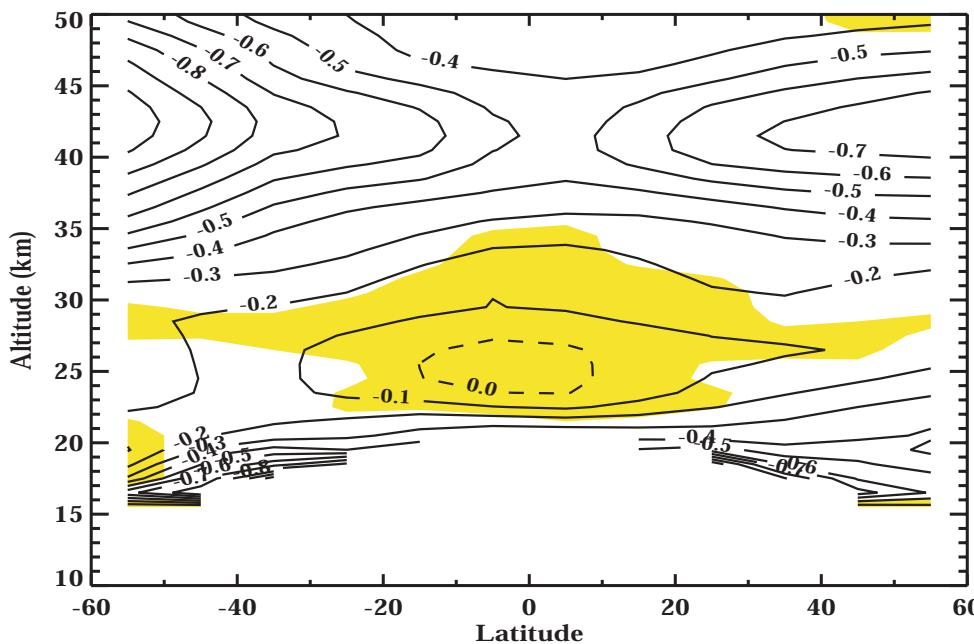
## SAGE-3 O<sub>3</sub> and PV in Dec. 2003 (lat.= 65-67 N)



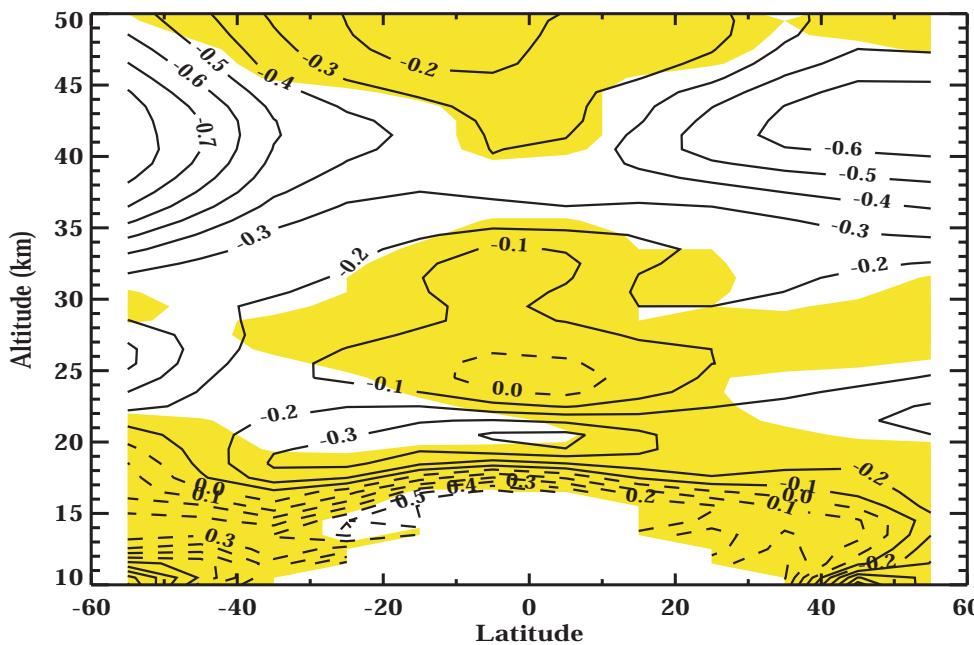
**30N-70N, 25340**



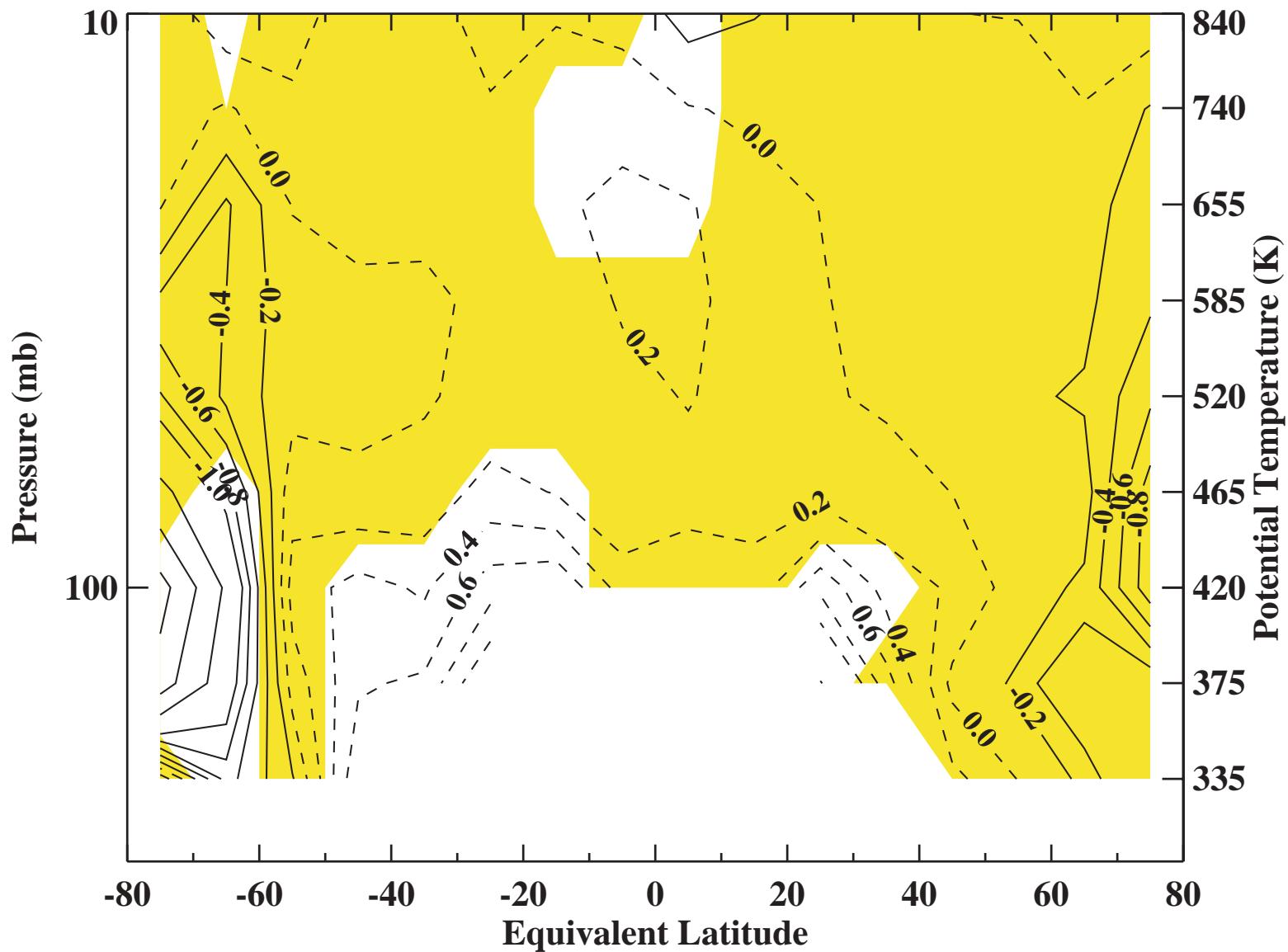
### SAGE I/II O<sub>3</sub> Trends 1979-2000 (%/year)



### SAGE-II O<sub>3</sub> Trends 1984-2000 (%/year)



## SAGE-II O<sub>3</sub> Trends 1984-1998 (%/year)



# Conclusions

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- ◆ Based on ozonesondes comparisons, SAGE-II ozone in the lower stratosphere has accuracy of
  - ~5%, from 30 km down to 5 km above the tropopause (similar or better than HALOE and POAM)
  - ~10%, between the tropopause and 5 km above the tropopause (more accurate than the other two instruments)
- ◆ Both SAGE-II and HALOE O<sub>3</sub> data show similar precision
  - ~5% above 25 km
  - ~20% at 18 km
  - ~40% below 15 km.

# Conclusion (continue)

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- ◆ Based on 10 month of data (5/2002 – 2/2003), SAGE-III (v2.0) ozone shows good agreements (within 10%) with correlative measurements from 12 to 50 km.
- ◆ Preliminary studies indicate SAGE-III NO<sub>2</sub> data has accuracy of 10% between 20 and 40 km
- ◆ PV/ $\theta$  mapping technique is a useful tool for O<sub>3</sub> validation in the LS/UT region